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CAMERA
[カメラ]

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(54) **[Title of the Invention]** **CAMERA**

(57) ABSTRACT

[Purpose of the Invention]

The purpose of the present invention is to provide a camera with optical elements whose surface can be cleaned without much effort, even in service conditions that make cleaning difficult.

[Constitutional Elements of the Invention]

The present invention is provided with a contaminant sensor 13 for detecting the adhesion of water drops, dust, etc., on the surface of the protective glass 2 of a camera 1 exposed externally, and an ultrasonic transducer 15 to provide ultrasonic vibration to the protective glass 2 in the event that the adhesion of water drops, dust, etc., is detected by the contaminant sensor 13.

[CLAIMS]

[Claim 1]

A camera characterized by being provided with an excitation means to excite an externally exposable optical element through ultrasonic vibration.

[Detailed Description of the Invention]

[0001]

[Industrial Application]

The present invention includes a camera, more specifically a camera that can allow the photographing of photographic objects with different gradation sequences.

[0002]

[Conventional Technology]

Contamination due to water drops and dust adhering to the foremost part of the optical elements of a camera that are exposed externally, such as the outer surface of a lens or the outer surface of a protective glass, diminishes the camera's resolution, articulation, etc. Conventionally, said contamination has typically been cleaned away by the using a silicon-impregnated cloth, etc., when the user found the lens dirty after a visual check.

[0003]

[Problems to Be Resolved by the Invention]

However, the method as mentioned above has required that the user perform a visual inspection every time, in addition to manually cleaning said surfaces, so that time and effort have been required for maintenance. Moreover, in the case of a camera such as an endoscope there has been the problem that, even when the surface of an optical

element becomes soiled by bodily fluids during use, etc., it is not possible to clean the surface of the optical element in that service condition following insertion into the human body.

[0004] With consideration for such problems of conventional cameras, the present invention aims to provide a camera that can allow the cleaning of the surface of the optical elements without much effort, even in service conditions that make cleaning difficult.

[0005]

[Means for Resolving the Problems]

The present invention is a camera provided with an excitation means that excites the externally exposed optical element through ultrasonic vibration.

[0006]

[Function]

The present invention excites ultrasonic vibration for the externally exposed optical element by the excitation means. For example, when dust is detected on the lens exposed externally, it excites the lens through ultrasonic vibration.

[0007]

[Examples]

The following is an explanation of an embodiment of the present invention with reference to the diagrams:

[0008] Figure 1 shows a main lineblock diagram of a video camera, as indicative of one embodiment of the present invention. In camera 1 of the present embodiment, the object light of photographic object 19 is captured by the focus lens 3 via the protective glass 2,which is the optical element disposed in an exposed manner at the front of the lens barrel part, further passes through the aperture 4, and carries out image formation on the image formation face of the image-sensing element 5. Said image-sensing element 5 converts an object image into an electric signal and outputs it to an imaging circuit 6. While the output signal from the imaging circuit 6 is directly output to another recording system as a video signal, it is input into the binarization processing circuit 7 and then output to another recording system as a binarization video signal. Furthermore, the video output signal from the imaging circuit 6 is also input to the image-region distinction circuit 8, which is an identification to identify the status of the gradation sequence of a photographic object. The image-region distinction circuit 8 discriminates the luminance of the video image on an imaging plane, as mentioned in the latter, and distinguishes the imaging plane between the gradation image region of the gray-scale image, which is the natural image region, and the simple binarized image region, which is the dither-processed character part. The abovementioned distinctive information signal of the image-region distinction circuit 8 is input to the binarization processing circuit 7, and a binarization processing adapted for each region is performed based on the distinctive information.

[0009] Furthermore, the video output signal of the abovementioned imaging circuit 6 is also input to the AF circuit 9, which is a selection means for selecting a photographing condition according to the result identified by the abovementioned identification means. The region distinction signal of the abovementioned image-region distinction circuit 8 is input to said AF circuit 9 as well. And in the event of searching for a focusing position, the focusing position of the focus lens 3 is obtained by taking the abovementioned region-distinction information into account, as mentioned in the latter. The information of the focusing position is output to the drive member 10.

[0010] Said drive member 10 drives the focusing operation of the focusing glass 3; the zooming operation of the zoom lens (not shown in the figures); the aperture 4; and, further, the ultrasonic transducer 15, which is an excitation means for removing contaminants such as water drops by employing ultrasonic vibration on the protective glass; in addition to performing the drive control of the imaging circuit 6, etc.

[0011] The contaminant sensor 13; which is a sensor that measures the electrical resistance of the side surface of the photographic object of the abovementioned protective glass 2, and detects the adhesion status of contaminants such as water drops; and the attachment contact point 14, which is a connecting means with a photographing attachment, are disposed in the foreside of the body tube. It is to be noted that said "photographing attachment" refers to, for example, a cylindrical

attachment that is mounted on the front part of the body tube of a camera in order to photograph the display image on the tubular surface of a measuring device such as an oscilloscope or a logic analyzer.

[0012] The control unit 11 controls the operation of said AF circuit 9; and the drive member 10 further directs the driving of the ultrasonic transducer 15 based on the detection signal from the abovementioned contaminant sensor 13 and performs the control during the photographing [operation] via the attachment that is input from the abovementioned attachment contact point 14. In addition, when there is a problematic condition such as, for example, the impossibility of performing a photographing operation while specifying/setting up the photographing of said attachment, the control unit 11 also controls the alarm 12 to generate an audible alarm. Additionally, the control unit 11 is connected with a switch block 11a comprising a switch to set up the automatic contaminant-removal mode for automatically driving the mode selection switch for setting the focusing and the abovementioned ultrasonic transducer 15 for the removal of contaminants according to the output of the contaminant sensor 13, etc.

[0013] Next, the function of removing, as needed, water drops, dust, etc., adhering to the lens barrel part of camera 1 according to the present embodiment is explained in the following. Accordingly, as shown in said Figure 1, the present invention vibrates the protective glass 2, which is the externally exposable optical element on the body tube, using the ultrasonic transducer 15, which is an ultrasonic

excitation means, and can perform contamination removal through means of shaking off adhering water drops, dust, etc., and thereby preventing the deterioration of resolution performance.

[0014] Next, the contaminant removal operation is explained in the following with reference to Figures 9 and 10. It is to be noted that, although ultrasonic vibration has been performed on the protective glass 2 disposed in the foreside of a body tube according to the present invention, if the camera lens is disposed in the foreside of the body tube the contaminant removal operation will be performed through ultrasonic vibration on the camera lens.

[0015] Figure 9 is the camera 1 of the present embodiment that is also shown in said Figure 1, particularly a lineblock diagram of the principal parts around the lens barrel part. As shown in this figure, an ultrasonic transducer 15 is mounted on the protective glass 2 disposed in the foreside of the body tube.

Further, the focus lens 3 can be driven in freely extendable and retractable manner via a focus motor 42 comprising an ultrasonic motor. The abovementioned ultrasonic transducer 15 and the focus motor 42 are driven via the control unit 11 and the drive member 41. The contaminant sensor 13 for detecting the adhesion of water drops, dust, etc., is mounted on the protective glass 2. And when water drops or dust adhere to the protective glass 2, the electrical resistance of said sensor 13 decreases and the adhesion of contaminants is detected by the control unit 11.

[0016] Also, by operating the switch block 11a connected to the control unit 11, the automatic contaminant-removal mode, which automatically removes the contaminant adhering to the protective glass 2, etc., is activated. And through a manual operation the ultrasonic transducer 15 is switched to the ON state. This also enables the selection of the manual contaminant-removal mode for removing contaminants, etc., and the contaminant-removal prohibition mode, which switches the ultrasonic transducer 15 to the OFF state.

[0017] Figure 10 is a flowchart of the contaminant removal process according to the abovementioned camera 1. As shown in this figure, the state of the switch 11a is first checked in step S31. When the abovementioned automatic contaminant-removal mode is set, it will advance to step S32 and check the adhesion status of the contaminant via the output of the contaminant sensor 13. When there is an adhering contaminant, it will advance to the later-explained step S33. When there is no adhering contaminant, it will jump to step S35 and terminate this routine by switching the ultrasonic transducer 15 to the OFF state.

[0018] Additionally, when the switch is ON based on the check during the abovementioned step S31, and when the manual contaminant-removal mode is set, it directly advances to the step S33 (explained later). Further, when the switch is OFF and the contaminant-removal prohibition mode is set, it will jump to step S35, turn the ultrasonic transducer 15 into an OFF state and terminate this routine.

[0019] When it advances to the abovementioned step S33, it checks whether the focus motor 42 is currently in the driving state. When the focus motor 42 is in the driving state, it jumps to step S35 (since the drive member 41 is shared with the drive of the ultrasonic transducer 15) switches the ultrasonic transducer 15 to the OFF state and terminates this routine. Or, when the focus motor 42 is not in the driving state it advances to step S34, starts driving the ultrasonic transducer 15 and executes the removal of the contaminant.

[0020] As explained above, the present camera can remove water drops, dust, etc., adhering to said protective glass 2 by carrying out the ultrasonic vibration of the protective glass 2 disposed in the foreside of a body tube using the ultrasonic transducer 15. Accordingly, it is very effective in applications such as when a camera is used in an environment where the user cannot clean the lens barrel part of the camera 1 (for example, a camera for endoscopes, etc.), or when the camera is inserted into the human body and therefore may encounter problems in the photographing operation due to the surface of the optical elements becoming soiled by bodily fluids, etc.

[0021] In addition, although in the abovementioned embodiment the ultrasonic transducer 15 is explained as sharing the drive member 41 with the focus motor 42 as the driving element, alternatively a separate drive member designated specifically for the ultrasonic transducer 15 can be provided therefore.

In this case a contaminant can be removed regardless of the drive of the focus motor 42.

[0022] Additionally, according to the abovementioned embodiment, the ultrasonic transducer 15 is explained as being driven via the detection result of the contaminant sensor 13. However, the embodiment is not limited thereto, and may have a configuration of, for example, driving the ultrasonic transducer 15 for a certain period of time whenever the switch of camera 1 is turned on. In this case the contaminant sensor 13 will no longer be necessary, thus enabling a simpler configuration. Meanwhile, cameras that can photograph binary images of the characters written on a blackboard, and character images such as prints, etc., have been commercialized in recent years.

[0023] On the other hand, the focusing of a conventional video camera has been performed by moving a camera lens to a focusing position through a so-called AF (auto-focusing) process. One of the AF systems thereof is the mountain-climbing method[1] (one of the passive methods), which detects the position indicative of the maximum of the contrast value extracted from the video signal at the center of the image plane and sets that position as the focusing position. Other than this method, there is an active method that uses infrared light or an ultrasonic wave. All of these methods are focusing techniques that subject the center part of the image plane, assuming that the photographic object is located in the center.

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1 Similar to the method so-called "contrast measurement" technique, known as one of the auto-focus methods.

[0024] However, when capturing a document image into a video camera, an AF processing that applies the abovementioned conventional mountain-climbing method, etc., is not suitable. That is because the applicable characters or a picture will not always be located at the center of the image plane (which is the focus range). For example, when attempting to photograph left- and right-side pages in a book by placing the book in an open condition so that both pages will fit on the image plane in its entirety, the valley part of the opened book will inevitably appear at the center. When this part is processed with said conventional AF system, there is a high possibility of erroneous-ranging.

[0025] Additionally, when imaging the characters written on a blackboard, the whiteboard, etc., using the AF processing that applies the conventional mountain-climbing method, etc., the abovementioned character part might not always be aligned at the center of the image plane, resulting in an occasional black part, or resulting in a white part at the center. Therefore, the abovementioned contrast-measurement AF system cannot provide contrast information and is accompanied by the high risk of utter "pin-bokeh" (blurred image) due to erroneous ranging.

[0026] Moreover, the abovementioned conventional camera with the capacity to photograph a binarized image of a document image is not suitable for the photographing of natural images (meaning ordinary gradation images). Furthermore, it is not suitable for the

photographing of an image plane where the binarized image and the natural image coexist.

[0027] The following is an explanation of an example of the abovementioned camera shown in Figure 1, as the method for resolving these problems with the conventional technology.

[0028] First, the image-region distinction operation in the abovementioned image-region distinction circuit 8 is explained as follows:

[0029] This image-region distinction operation is a process of dividing one photographing image plane into the following three image-plane regions according to the frequency-level histogram of the image data corresponding to each luminance of the applicable region on [said image plane]. Concerning the isolation regions, in one photographing-image plane G0 as shown in Figure 2, the first one is region R1, whose image is a natural image (gradation image), and wherein the frequency level corresponding to all the luminance ranges is present evenly. Another one is region R2, wherein the frequency level is high for two luminances of white/black like the images with characters, etc. Still another one is region R3, which has the state of the background part of the original copy, and wherein the level is high for the luminance range of either white or black. The histogram property for the abovementioned luminance has property HA shown in (A) of Figure 3 in region R1, has the property HB with two peaks of black and white as shown in (B) of Figure 3 in region R2, and has a peak either of property HC or HD shown in (C) of Figure 3 in region R3. It is to be

noted that the property HC is the histogram corresponding to a black background and the property HD is the histogram corresponding to a white background.

[0030] The camera, according to the present embodiment, contrasts the histogram property of the luminance of every given unit-region B*n* (see Figure 2) of one image plane of the video-image data, as captured by the image-sensing element 5, with the histogram property relative to the abovementioned luminance shown in the Figure 3; and discriminates and isolates the abovementioned image plane into three regions: R1, R2 and R3. This distinction processing is performed by said image-region distinction circuit 8. And the degrees of the area sizes of said regions R1, R2 and R3 are discriminated by a selection means built into the control unit 11; an appropriate focusing region is set up, and the AF processing is performed.

[0031] Next, AF processing of the camera according to the present embodiment formed, as mentioned above, is explained in the following with reference to the flowcharts, etc., in Figures 4 and 5; however, before the explanation thereof, the process of the mountain-climbing AF method is first explained.

[0032] Figure 6 is a line graph showing the variation character curve CA of the contrast value, which is the AF rating value for the reel-out position of the focus lens 3 of the abovementioned camera. The focusing point P4 that is the peak point of tracing the characteristic curve CA from the starting point P1 is detected during the aforementioned mountain-climbing AF processing. The process can be

divided into four processes. Accordingly, the first process Q1 verifies the direction of the mountain climbing and moves the lens 3 in the proper direction. The second process Q2 moves the lens 3 further to a uniform direction, verifying the increase in contrast value. The third process Q3 confirms that it has crossed the peak based on the contrast value decreasing once, and moves the lens 3 in the opposite direction.

The fourth process Q4 moves the lens 3 up in the opposite direction to the focusing position P4 of the peak indicative of the maximum of the past contrite value, then terminates the focus drive.

[0033] Now, in the AF processing of the camera according to the present embodiment, as shown in the flowchart of Figure 4, first at step S11 it determines whether it is in the focusing state to the extent that image-region distinction is possible. Because this image-region distinction processing checks the histogram property of the luminance of said Figure 3, focusing with rough accuracy needs to be completed in advance. Given this factor, the check at the abovementioned step S11 is required. Said "focusing with rough accuracy" is, for example, a state where the lens 3 is located on the range B of the third process Q3, as shown at least with the line graph of Figure 6.

[0034] And when the lens 3 is out of the abovementioned range B and it is deemed impossible to discriminate the image region, it advances to step S12 and sets up the focusing region at the center. Figure 7 shows focusing region R0 set up at the center relative to the image plane

G1. In step S13 it executes the subroutine "the first mountain-climbing AF processing." This mountain-climbing AF processing is an AF processing with rough accuracy. In the AF process shown in Figure 6, the processing of the first through third processes Q1, Q2, and Q3 are executed, and thereby the lens 3 is driven into the range B. This AF processing requires high-speed performance and can be performed with an external ranging sensor. Additionally, when the contrast value is taken through a filter of different properties, for example, it indicates different properties as the property CB shown in the property lines of Figure 6. When it is close to the focusing position, the contrast value changes significantly. It can perform AF processing with the two filters utilizing the property. The AF processing can be performed with two filters utilizing the characteristics thereof.

[0035] Subsequently, the subroutine "the determine the focusing area" is executed at step S14. This process selects the region to be focused based on the percentage of the area size of the image regions R1 and R2 in the image, which is the result of the image-region distinction as mentioned in the latter. Following said subroutine processing, it advances to step S15 and executes the second mountain-climbing AF processing pertaining to the abovementioned area to be focused. This mountain-climbing AF processing executes the entire process of the abovementioned AF process Q1, Q2, Q3, and Q4, as shown in Figure 6, and detects the focusing position P4. However, in order to accelerate the AF processing speed it may be started from the inside of the range

B and can terminate the AF processing using only the processes Q3 and Q4.

[0036] Figure 5 is a flowchart of said subroutine, "the focusing area discrimination." First, in step S21, for example, the result of the image-region distinction of the image data of the image plane G0 shown in said Figure 2 (namely, the position and area size data of said region pertaining to the gradation image region R1 and the binarized image region R2) is retrieved. And in step S22 the switch block 11a of the control unit 11 checks the specified focusing area mode. If the mode is set to set up the focusing area at the center part, it will jump to step S27, whereas if the mode is set to perform focusing on the gradation image it will jump to step S28. If it is set up to Auto, it will advance to step S23.

[0037] In case it jumps to the abovementioned step S27, it sets the center part R0 of said Figure 7 as the focusing area. In case it jumps to the abovementioned step S28, it sets the abovementioned gradation image region R1 as the focusing area.

[0038] In case it advances to the abovementioned step S23, it checks the size of the area of the abovementioned binarized image region R2. And when the area size is more than one-fifth the area size of one image plane, it jumps to step S25 and sets the binarized image region R2 as the focusing area. When the area size of region R2 is less than one-fifth, it will advance to step S24. Then, having calculated the total of the area size of the gradation image region R1 and the binarized image region R2, if said total area size is more than one-

fifth the area size of one image plane, it jumps to step S26 and sets both regions of the gradation image region R1 and the binarized image region R2 as the focusing area. Further, if said total area size is less than one-fifth the area size of one image plane, it jumps to step S27 and sets the central area as the focusing area.

[0039] After completing the setting of the focusing area as mentioned above, it finishes this routine and subsequently performs the second mountain-climbing process of step S15 shown in said Figure 4.

[0040] It is to be noted that, as a modified example that can alternatively be applied to the abovementioned discrimination of the focusing area and the AF processing, weighting for the gradation image region R1 and the binarized image region R2 can be performed in order to perform the AF processing with consideration for the weighting. For example, the weighting coefficient may be set at 0.3 for the gradation image region R1 and at 0.7 for the binarized image region R2. However, for region R3 (the background area of the original copy), the weighting [coefficient] is set at the value of 0. Thereby, a AF processing can be performed by applying, to the evaluation of the focusing position, the value obtained by multiplying each weighting by the area size of the region concerned.

[0041] As mentioned above, according to the AF processing of the camera according to the present embodiment, a high-precision AF becomes possible by, after performing a rough focusing operation at high speed, determining the focusing area needed to obtain the AF rating value through an image-region distinction processing according

to the discriminated gradation image region R1 and binarized image region R2, or through the region R3 (the background area of the original copy). Moreover, because the focusing area can be changed at this time according to each area size, the AF rating value as the focus information can be captured with greater accuracy.

[0042] Additionally, the present embodiment uses the image-region distinction information to set up the focusing area for AF processing; or, alternatively, said image-region distinction information can be used to set up the exposing condition of AE processing (automatic exposure control). [0043] As mentioned above, the camera of present embodiment photographs discriminates the status of the gradation of the photographic object and selects the photographing condition according to the discriminated result. Accordingly, even when the image plane to be photographed is a binarized image of a document image or an ordinary natural image, or when it is an image plane with the combination of these images, it becomes possible to set up the optimal photographing condition automatically.

[0044] Next, the operation when photographing the display screen of the tubular surface of a measuring device (such as an oscilloscope or a logic analyzer) using this camera 1 is explained in the following:

[0045] Figure 8 shows the principal part of camera 1 of the block diagram in said Figure 1, a photographing attachment 21 and an adapter 22 being mounted in the foreside of the body tube of said camera 1; and said adapter 22 being attached to the display tube surface part 33a of the abovementioned measuring device 31. The signals such as

trigger signal information, sweep speed information, and luminance information of the display part are retrieved into the control unit 11 of the camera 1 from the control unit 32 built into the measuring device 31 via a mount-condition detection sensor 24 (which is the connecting means), and further via an attachment contact point 14 (which is the connecting means of camera 1). Additionally, the available sizes of the abovementioned tubular surface 33a are 6" - 7". While the conventional technology employed a specifically designated attachment, the present embodiment uses an adapter 22 for adjustment. The angle-of-view information, including the horizontal to vertical ratio, etc., is stored in a frame memory 23 with a built-in attachment, and is retrieved into the control unit 11 via the abovementioned attachment contact point 14. In addition, the focus information (information on the length of the attachment) is further stored in the abovementioned memory 23.

[0046] When mounted with the abovementioned adapter 22 or the photographing attachment 21, and when the mounting condition is faulty, a signal indicating a connection loss is output from the abovementioned mount-condition detection sensor 24 or the attachment contact point 14. In this case the control unit 11 prohibits the trigger and generates an alarm from the alarm 12.

[0047] When mounted with a photographing attachment 21 and an adapter 22, the control unit 11 retrieves the angle-of-view information in the frame memory 23. And it performs zooming on the camera side and sets up the angle of view so as to make it match the dimensions of the

display tube surface 33a of the measuring device 31. Further, when focusing as well, it retrieves the focus information in the frame memory 23, performs focusing on the camera side and sets the display tube surface 33a of the measuring device 31 as the object position. In addition, when such zooming and focusing exceeds the control range, an alarm is generated from the abovementioned alarm 12.

[0048] Also, the display luminance information on the tubular surface 33a, as output from the measuring device 31, is retrieved into the control unit 11 as described above, and the shutter and aperture are controlled. At this time as well, when a reasonable exposure cannot be ensured, an alarm is generated from the alarm 12.

[0049] Furthermore, when the measuring device 31 provides a single-mode display, the trigger signal of the measuring device 31 is retrieved into the control unit 11 and the shutter clicks at the camera side.

The sweep-rate information is also retrieved into the control unit 11 so as to set the shutter speed of the camera. In this case as well, when it exceeds the configurable shutter-speed range an alarm is generated from the alarm 12.

[0050]

[Effect of the Invention]

As is clearly understood from the above explanations, the camera according to the present invention has the advantage that it can allow

the cleaning of the surface of the optical elements without much effort and even in service conditions that make cleaning difficult.

[Brief Description of the Diagrams]

Figure 1 is a main lineblock diagram of the camera indicative of one embodiment of the present invention.

Figure 2 shows the image-region distinction of one image plane by means of the image-region distinction processing, which is performed in the abovementioned camera in Figure 1.

Figure 3 shows an example of the histogram indicative of the frequency of the image data relative to the luminance of the image data in the region that was processed through the abovementioned image-region distinction in Figure 2, wherein (A) is the histogram for a gradation range R1, (B) is the histogram for a simple binarized region R2 and (C) is the histogram for a region R3 of the background of the original copy.

Figure 4 is a flowchart of AF processing in the abovementioned camera in Figure 1.

Figure 5 is a flowchart of the subroutine processing of "determine the focusing area," which is called out by the abovementioned AF process in Figure 4.

Figure 6 shows the mountain-climbing AF process in the abovementioned camera of Figure 1.

Figure 7 shows the focusing area located in the middle of the image plane by AF processing in the abovementioned camera in Figure 1.

Figure 8 is a lineblock diagram in the condition of photographing the display tube surface of the measuring device utilizing the photographing attachment, in the abovementioned camera in Figure 1.

Figure 9 is a lineblock diagram of the principal part in the condition of performing the contaminant removal process of the abovementioned camera in Figure 1.

Figure 10 is a flowchart of the contaminant removal process of the abovementioned camera in Figure 1.

[Description of Notations]

2 Protective Glass

8 Image-region Distinction Circuit (Identification Means)

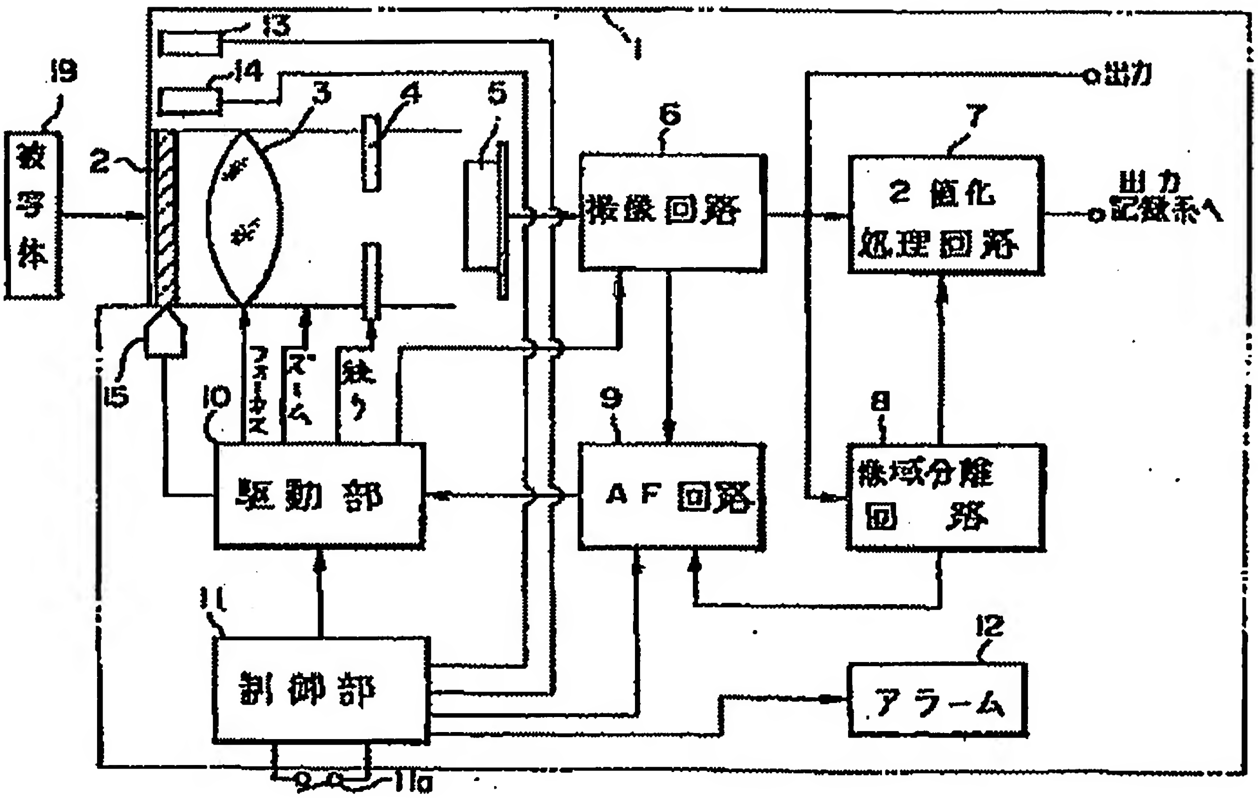
11 Control Unit (Selecting Means)

13 Contaminant Sensor

15 Ultrasonic Transducer (Excitation Means)

7 Pages of drawings follow

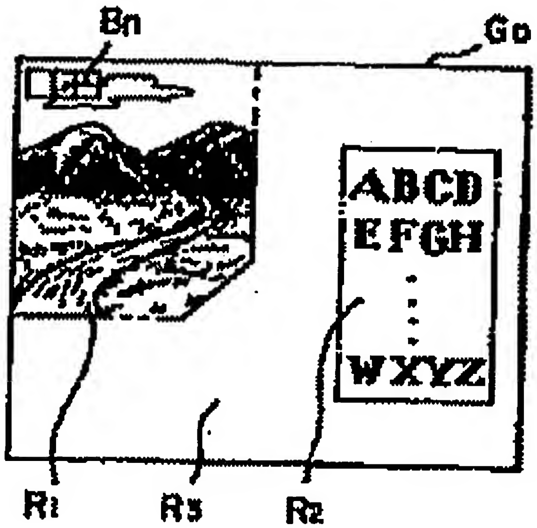
[Figure 1]



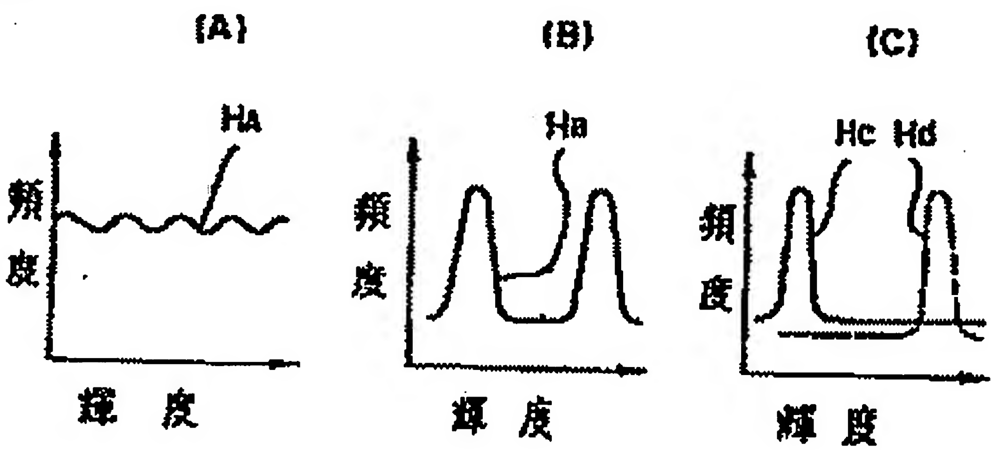
6 Imaging circuit
7 Binarization processing circuit
8 Image-region distinction circuit
9 AF circuit
10. Drive member
[Letters above from the left: Focus, Zoom, Aperture]
11 Control unit
12 Alarm
19 Photographing object

[Letters on the upper right]
Output
Output to recording system

[Figure 2]

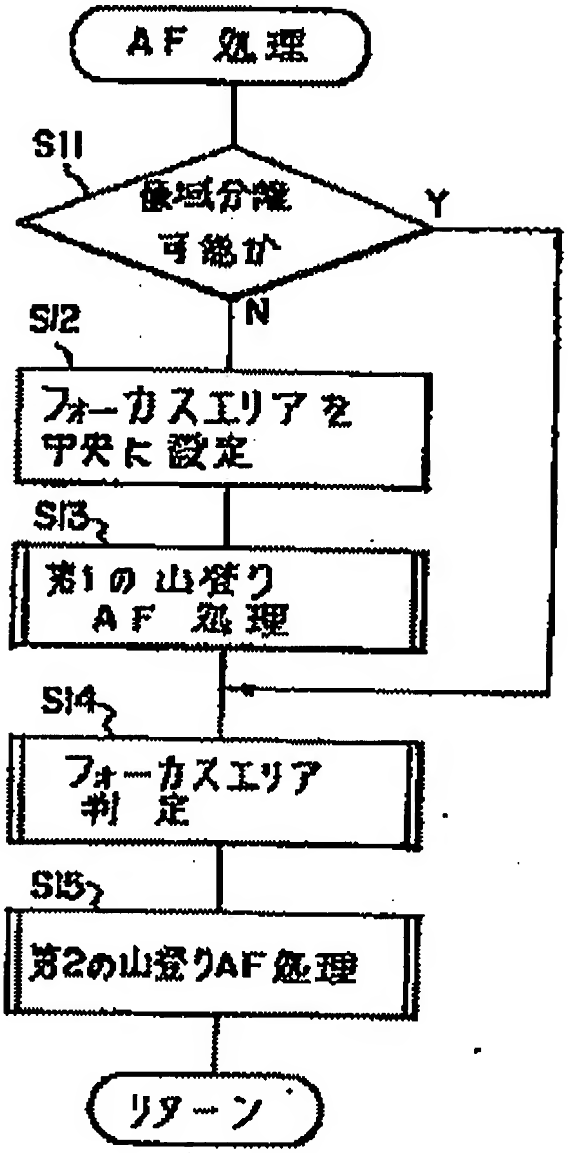


[Figure 3]



X-axis Luminance
Y-axis Frequency

[Figure 4]



AF processing

Possible to perform image-region distinction?

Set the focus area at the center

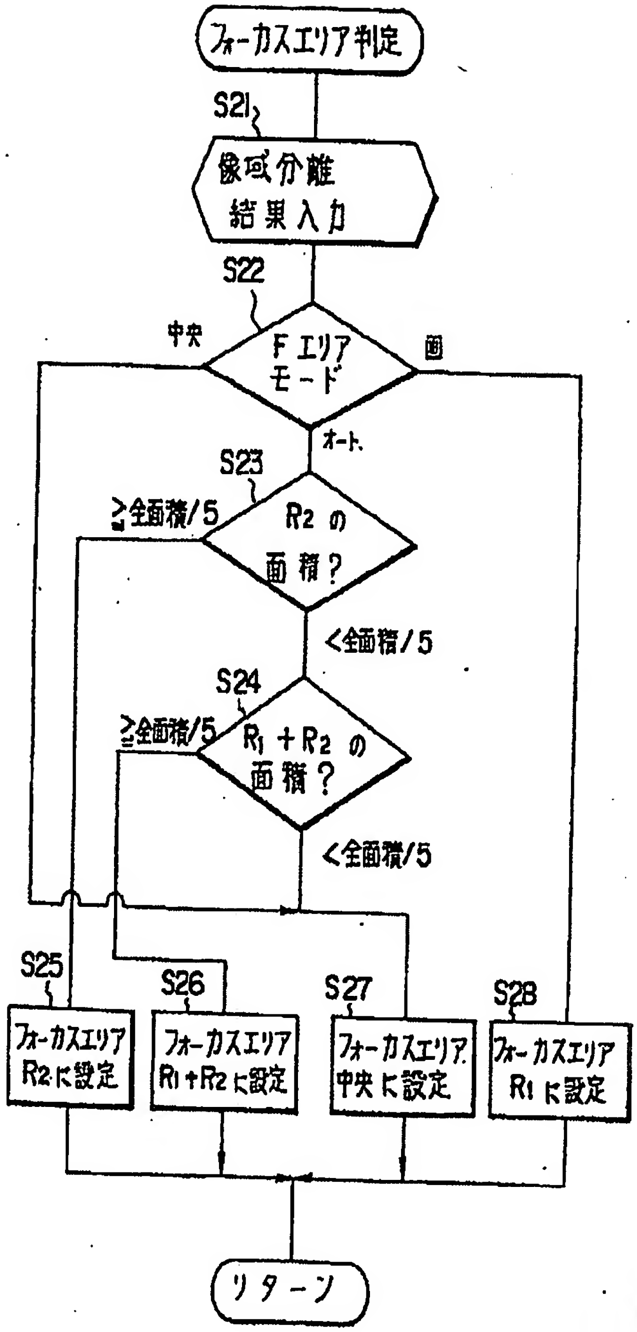
The first mountain-climbing AF processing

Determine the focus area

The second mountain-climbing AF processing

Return

[Figure 5]



Determine the focusing area

Input the result of the image-region distinction

F-area mode
[Letter on the left] Center
[Letter on the right] Image
[Letter at the bottom] Auto

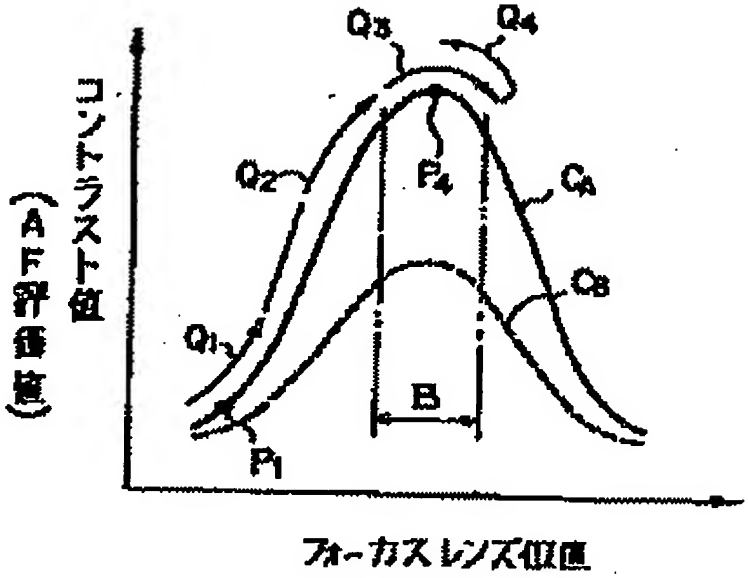
Area size of R2?
[Letter on the left] ≥Total area/5
[Letter at the bottom] < Total area/5

Area size of R1 + R2?
[Letter on the left] ≥Total area/5
[Letter at the left] < Total area/5

S25 Set the focus area at R2
S26 Set the focus area at R1 + R2
S27 Set the focus area at the center
S28 Set the focus area at R1

Return

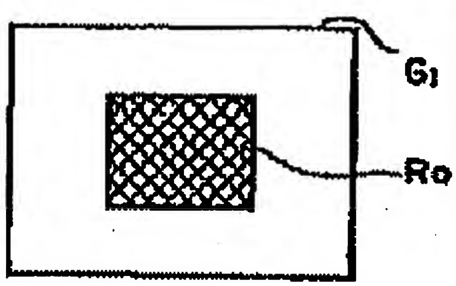
[Figure 6]



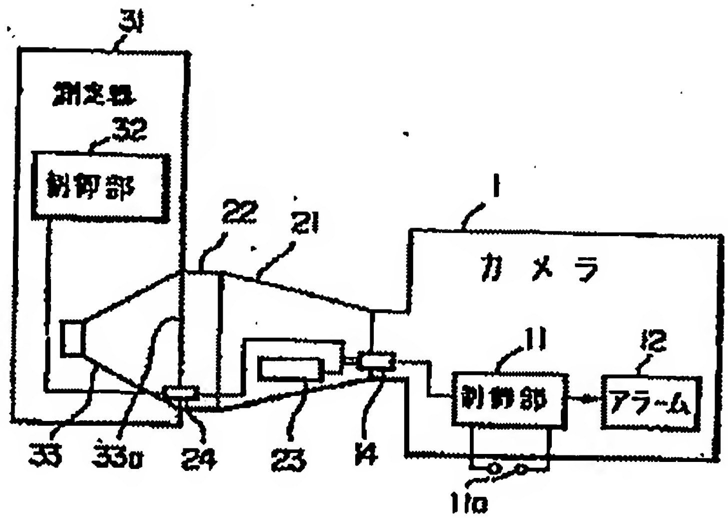
X-axis Focus lens position

Y-axis Contrast value (AF rating value)

[Figure 7]



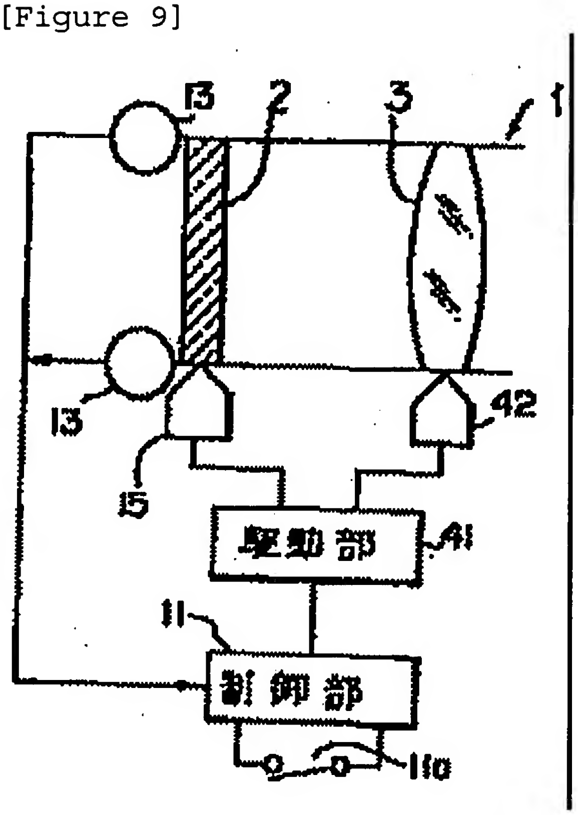
[Figure 8]



31 Measurement device
32 Control unit

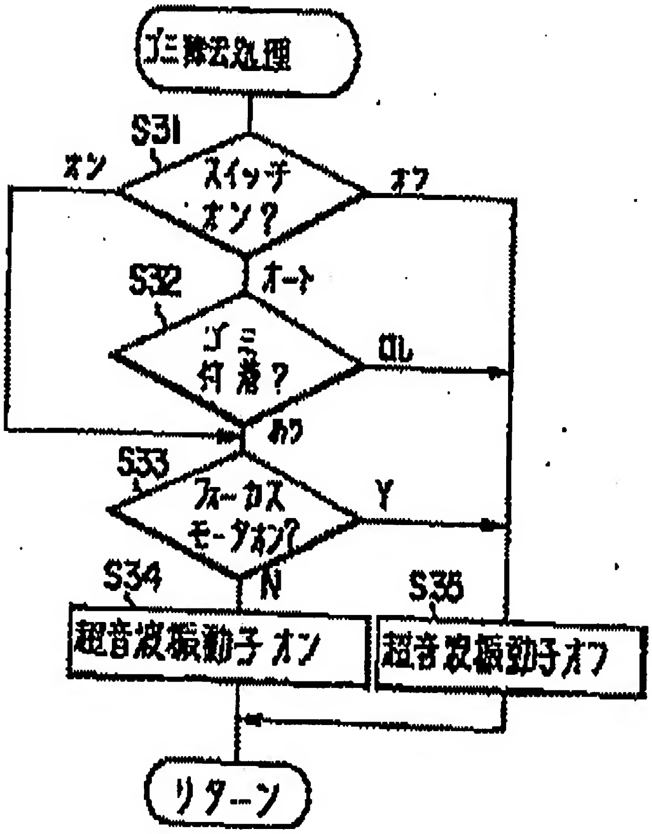
1 Camera
11 Control unit
12 Alarm

[Figure 9]



41 Drive member
11 Control unit

[Figure 10]



Contamination removal processing

S31 Switch ON?
[Letter on the left] ON
[Letter on the right] OFF
[Letter at the bottom] AUTO

S32 Adhesion of any contaminant?
[Letter on the right] NONE
[Letter at the bottom] YES

S33 Focus motor ON?

S34 Ultrasonic transducer ON
S35 Ultrasonic transducer OFF

Return